THEORETICAL NOTE

Four Postulates on the Structure of Standard Model Parameters and a Testable Prediction at 6833 GeV

Speculative framework — no Lagrangian derivation provided

Judicael Brindel, Independent Researcher, Cotonou, Benin
ORCID: 0009-0007-4590-9874

February 2026

Abstract. We propose four postulates summarizing the numerical observations reported in previous work [1–5]. Postulate 1: electroweak and strong couplings have the form N/(17×f(φ,5)), where N is a Standard Model particle count and 17 is the total particle count. Postulate 2: fermion-to-electron mass ratios have the form (6+2n)×5^(3n/4)×π^(5+2k), where n indexes the pentagon geometry and k counts energy scale crossings. Postulate 3: φ emerges from the rank-5 structure of SO(10) via pentagon geometry. Postulate 4: k increases by 1 each time a fermion mass crosses the W boson mass scale. These postulates are mutually consistent and generate a testable prediction: a hypothetical fourth-generation fermion following this pattern would have mass $\approx 12\times5^{(9/4)}\times\pi^9\times m_e \approx 6833$ GeV, beyond current LHC reach but accessible to a future 100 TeV collider. The dichotomy φ (couplings) vs π (masses) is identified as a possible distinction between geometric structure and quantum dynamics.

1. Context

This note synthesizes and formalizes the following previously reported numerical observations:

- $\sin^2\theta_W = 5/(17\sqrt{\varphi}) — 0.033\sigma$ [1]
- Five PMNS and CKM mixing angles expressed via 5, 17, φ — all within 1σ [2]
- $\alpha_s(m_z) = 3/(17\times5^{(1/4)}) — 0.014\sigma$ [3]
- $m^b/m_e = 8\times5^{(3/4)}\times\pi^5 — 0.001\sigma$ [4]
- $m_t/m_e = 10\times5^{(3/2)}\times\pi^7 — 0.056\sigma$ [5]

We now propose four postulates that unify these observations into a coherent, testable framework.

2. The Four Postulates

Postulate 1 — Couplings

> *Dimensionless couplings of the Standard Model have the form N / (17 × f(φ, 5)), where N is the count of a physically meaningful particle subset and f is a function of the golden ratio φ and the integer 5.*

Instances verified:

- $\sin^2\theta_W = 5/(17\sqrt{\varphi})$ — N = 5 (bosons), f = √φ
- $\alpha_s = 3/(17\times5^{(1/4)})$ — N = 3 (colour charges), f = 5^(1/4)

Postulate 2 — Masses

> *Fermion-to-electron mass ratios have the form (6+2n) × 5^(3n/4) × π^(5+2k), where n = 0,1,2,… indexes the pentagon correction and k = 0,1,2,… counts the number of electroweak scale crossings.*

Instances verified:

- $m_m/m_e \approx 6\times\pi^5$ — n=0, k=0
- $m^b/m_e = 8\times5\text{^}(3/4)\times\pi^5$ — n=1, k=0
- $m_t/m_e = 10\times5\text{^}(3/2)\times\pi^7$ — n=2, k=1

Postulate 3 — Origin of φ

> *The golden ratio φ arises from the rank-5 structure of the SO(10) grand unification group via the geometry of the regular pentagon: cos(36°) = φ/2 exactly. The integer 17 arises from the SO(10) spinor representation (dimension 16) plus the Higgs boson.*

This postulate is algebraically exact: cos(36°) = φ/2 is an identity, not an approximation. The rank of SO(10) is 5 by definition.

Postulate 4 — Scale Crossings

> *The exponent k in π^(5+2k) counts the number of times the fermion mass crosses a fundamental scale threshold. The W boson mass ($m^W \approx 80.4$ GeV) is the first such threshold. Fermions with mass < m^W have k=0. The top quark, the only Standard Model fermion with mass > m^W, has k=1.*

Physical basis: the top quark is the only fermion that decays via the weak interaction before hadronization. It exists at the electroweak scale, not the QCD scale. This is a qualitative distinction from all other fermions.

3. Internal Consistency

Fermion	Formula	n	k	C=6+2n	Dev.
Proton	$6\times\pi^5$ + series	0	0	6	**$<10^{-12}\sigma$**
Bottom quark	$8\times5\text{^}(3/4)\times\pi^5$	1	0	8	**0.001σ**
Top quark	$10\times5\text{^}(3/2)\times\pi^7$	2	1	10	**0.056σ**
4th gen. (pred.)	**$12\times5\text{^}(9/4)\times\pi^9$**	3	?	12	*prediction*

The fourth row is a prediction, not an observation.

4. Testable Prediction: 6833 GeV

If Postulate 2 holds and a fourth-generation fermion exists with n=3 and k=1 (mass above m^W), its mass ratio would be:

$$\mathbf{m_4/m_e = 12 \times 5\text{^}(9/4) \times \pi^9}$$

Numerically: $12\times5\text{^}(9/4)\times\pi^9 \approx 1.337\times10^7$, giving **$m_4 \approx 6833$ GeV = 6.833 TeV.**

This prediction is:

- Beyond the current LHC reach (√ s = 13–14 TeV, but exclusion limits around 1–2 TeV for fourth-generation quarks)
- Within the projected reach of the FCC-hh (100 TeV centre-of-mass energy, 2040s)
- Falsifiable: if no fourth-generation fermion is found below ~10 TeV, the pattern is ruled out

Caveat: fourth-generation quarks are strongly constrained by Higgs boson measurements. This prediction assumes the postulate holds and that theoretical constraints can be satisfied.

5. The φ vs π Dichotomy

A striking feature of the postulates is that φ appears exclusively in couplings, while π appears exclusively in mass ratios.

Type	Observable	Formula	Constant
Coupling	$\sin^2\theta w$	$5/(17\sqrt{\varphi})$	φ
Coupling	α_s	$3/(17\times5^{(1/4)})$	φ (via $\sqrt{5}=2\varphi-1$)
Mass ratio	m_m/m_e	$6\pi^5 + \ldots$	π
Mass ratio	m^b/m_e	$8\times5^{(3/4)}\times\pi^5$	π
Mass ratio	m_t/m_e	$10\times5^{(3/2)}\times\pi^7$	π

φ governs couplings. π governs mass ratios. The integer 5 appears in both.

We propose the following interpretation:

- **φ encodes structure:** the golden ratio is a geometric constant arising from the rank-5 symmetry group SO(10). Couplings reflect the symmetry structure of the theory.
- **π encodes dynamics:** π appears naturally in loop integrals and propagators of quantum field theory. Mass ratios reflect the dynamical content — Yukawa couplings, renormalization group running, symmetry breaking.

If this interpretation is correct, the separation of φ and π reflects a deep distinction between the geometric skeleton of the theory (SO(10) symmetry) and its quantum dynamics (QFT loops and renormalization).

6. What Is Missing

These postulates are empirical. The following are required to make them rigorous:

- A derivation of Postulate 1 from the SO(10) Lagrangian and its symmetry breaking chain
- An explanation of why the coefficient C = 6+2n and exponent 3n/4 arise for the specific fermions mp, mb, mt
- A theoretical basis for Postulate 4 — why does the W mass threshold produce a factor of π^2?
- A derivation of why φ appears in couplings but not in mass ratios, and π in mass ratios but not in couplings
- Reconciliation of the fourth-generation prediction with Higgs coupling measurements

References

[1] J. Brindel, "A Numerical Observation on the Weak Mixing Angle", Zenodo (2026). DOI: 10.5281/zenodo.18710136

[2] J. Brindel, "The 5–17–φ Pattern in Electroweak and Flavour Mixing Angles", Zenodo (2026). DOI: 10.5281/zenodo.18722019

[3] J. Brindel, "A Numerical Observation on the Strong Coupling Constant", Zenodo (2026).

[4] J. Brindel, "A Numerical Observation on the Bottom Quark Mass Ratio", Zenodo (2026).

[5] J. Brindel, "A π^n Pattern in Fermion Mass Ratios", Zenodo (2026). DOI: 10.5281/zenodo.18726090

[6] PDG 2024, Particle Data Group. https://pdg.lbl.gov

Working note deposited to Internet Archive, February 2026. Priority established by date by Judicael Brindel